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An Investigation of the Association between Social Capital and County Level Chlamydia Rates in Georgia

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By

Blair Turner

Bachelor of Science
The Ohio State University
2014

Thesis Committee Chair: Dr. Michael Kramer, MS, PhD

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

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By Blair Turner

Chlamydia, a sexually transmitted infection, is the most commonly reportable notifiable disease in the United States, with racial and gender disparities. In health research, areas with high social capital often have better health outcomes. However, it is often assumed that all individuals in a geographic area benefit from social capital equally. To understand this relationship, Georgia county chlamydia data from Georgia Department of Public Health as accessed through their online system OASIS and an index of social capital developed by Ruspingha is used to investigate the assumption that the association between social capital and chlamydia is homogenous by race and gender.

This study employs multi-level Poisson regression to test three models, controlling for demographic covariate, county level covariates, and the three-way interaction between social capital, sex, and race, with chlamydia as the outcome variable and county social capital as the exposure.

Results indicate there is a significant three-way interaction between social capital, sex and race, and the assumption that every demographic group in a particular geographic area benefits from social capital equally may not be accurate. The association between social capital and chlamydia was found to be opposite for blacks and whites. For whites, areas with more social capital had lower the rates of disease, and for blacks areas with more social capital yielded higher the rates of disease. This relationship was found to be true for both men and women, but more intense among men. Among black men, the prevalence of chlamydia in counties with very low social capital was half as high compared to the prevalence of chlamydia in areas with very high social capital (PR, 0.47; 95% CI, (0.31, 0.71). The opposite was found among white men, the prevalence of chlamydia in counties with very low social capital was 1.12 times higher than the prevalence of chlamydia in counties with very high social capital (95% CI, (0.85- 1.48).

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Background

Introduction

Chlamydia (C.*trachomatis*), a sexually transmitted infection (STI), is the most commonly reported notifiable disease in the United States (1,2). In 2013, 1,401,906 chlamydial infections were reported to the Center for Disease Control and Prevention (CDC) (1). In 2012, Georgia had the 7th highest chlamydia incidence rates in the United States, with 52,336 reported cases (2). However, cases of chlamydia are not evenly spread throughout the population. There are racial, age, and gender disparities in the rates of chlamydia throughout the United States and Georgia (1,2). In Georgia, young adults, women, and African Americans have disproportionately higher chlamydia rates when compared to older, male, and white counterparts (2).

The association between the social capital available to a group or place, and the health status of individual members of that group or place has been frequently studied over the past 20 years. Social capital is the collective social resources possessed within and by a group and available to them. Research has shown that the more social capital in an area, the better the health outcomes of the residents (1,2, 3,4). However, it is often assumed that all individuals in a geographic area benefit from social capital equally. This study examines county-level chlamydia rates in Georgia, in order to investigate the assumption that social capital has a homogenous effect by race, and gender on chlamydia incidence, ultimately providing a better understanding of the disparities associated with chlamydia. This information can be used to develop more targeted chlamydia control measures. This study advances our knowledge of social capital and health by examining the association separately in sub-groups classified by race and gender for an infectious disease outcome.

Chlamydia and its Disparities

Chlamydia (C.*trachomatis*), a sexually transmitted infection (STI), is the most commonly reported notifiable disease in the United States (1,2). In 2013, 1,401,906 chlamydial infections were reported to the Center for Disease Control and Prevention (CDC) (1). In 2012, Georgia ranked 7th highest chlamydia incidence rates in the United States, with 52,336 reported cases (2). However, the distribution of these cases of chlamydia is not evenly spread among different age groups, races, and genders, indicating clear disparities in chlamydia rates. In both the US and Georgia the rate of chlamydia among blacks is 6.4 times the rate among whites (1,2). Prevalence estimates suggest that young people aged 15-24 years of age acquire half of all new STIs in the US (5). The same trend holds true in Georgia, where 15-24 year olds account for 71% of reported cases of chlamydia (2). Similar to race and age, there are also disparities in chlamydia rates among genders. In Georgia, women accounted for 72% of the reported cases of chlamydia (2). Even within the same gender and age groups there are still racial disparities in chlamydia rates. For example, in the US, the rate of chlamydia among black men aged 15-19 is 9.5 times the rate of similarly aged white men (1). The data is evident that race, age, and gender disparities exist in chlamydia rates both in the US and in Georgia.

Mechanism for Disparities in STI

There have been several mechanisms postulated to explain the age, gender, and race disparities in sexually transmitted infections. Three major hypothesized mechanisms are differential access to health care, socioeconomic status, and residential segregation (6,7, 8). Access to relevant health care is essential to STI prevention (6,9,10). Without access to health care a person does not have the opportunity to receive necessary education, materials, and screening to prevent STIs. Uninsured people are less likely to receive preventative education and care, and are more likely to have a chlamydial infection (7,11). Lack of access to care, in conjunction with life-stage specific sexual networks, is hypothesized to explain why new STI infections occur disproportionally among people under the age of 24. The higher prevalence of STIs among adolescents is thought to be caused by barriers in accessing quality STD prevention services, including the ability to pay, lack of transportation, and discomfort with facilities and services designed for adults and concerns about confidentiality (1). Young adolescents may rely on their parents/guardians to provide them money and transportation. Without their parents/guardians they do not have adequate access to STI prevention services, resulting in age disparities among STIs.

The second hypothesized mechanism for the age and racial disparities among STI rates is socioeconomic status (SES). As defined by the American Psychological Association, SES is a combination of education, income and occupation (12). This combination of factors have been shown to result in age and racial disparities among STI rates. The lack of resources and inequality of resource distribution may lead to risky sexual behavior, lack of health care, and rising STI rates (6,13,14). STI rates tend to be higher in countries that have higher income inequality (6). Having low SES can result in a person not having the financial means necessary to prevent themselves from contracting an STI such as chlamydia. For example, a person of low SES may not be able to afford condoms or regular STI screening, resulting in them contracting and or spreading a STI.

Social segregation, an outcome of structural racism, is a fundamental mechanism for disparities in STIs (6,8). Segregation in the United States was legally abolished with the passage of the Civil Rights Act of 1965. However, segregation in the US still exists today. Segregation working in combination with access to healthcare and SES further exacerbates disparities in STIs. In addition, areas of social disorganization in segregated communities further reduce access to health care, creating greater disparities in STI rates (6,15). For example, gang activity in some areas can constraint movement within and between areas resulting in reduced access to health care facilities (6). As a result of racism and segregation, populations of minority groups have suffered disproportionate poverty and have fewer employment and educational opportunities, resulting in lower levels of SES and higher levels of STIs (6). Segregation in a geographic area could be a result of social stratification of space and between groups with different amounts of power and resources. The process of social-spatial stratification results not only in physical separation of groups, but in the differing availability of leveraging collective political and social power to achieve collective aims. Segregation may promote social disorganization. This study examines this relationship by evaluating race as an effect modifier on the association between social capital and STIs. Access to health care, SES, and segregation are critical mechanisms to explain the age, gender, and racial disparities in STIs.

What is Social Capital?

Social capital is a term that has been used throughout social science research for a many years. In 1920, Lyda Hanifan first defined social capital as the resource of community participation in sharing local educational outcomes (16,17). As time has passed the definition of social capital has evolved, and each researcher defines social capital slightly different. However, all of the various definitions of social capital encompass two major themes; collective measures and social organization. The first, Coleman argues, is that social capital is an attribute of the collective rather than the individual (17,18,19). Coleman expressed that social capital is defined by its function. Social capital is not a single entity, but a variety of different entities having two characteristics in common. They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure (17,19). By having a connection with one's social structure, social capital provides benefits to the individual that they would not otherwise have on their own. With Coleman's definition everyone within the same structure has the same benefits from social capital, thus it is a collective measure. The second theme of social capital presented by Putman states social capital is a notion of resources collectively possessed (17). Putnam defines social capital as features of social organization, such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit (20,21). Putnam's definition is the most cited definition for social capital in health research (17). Combining the themes of

Coleman and Putnam, social capital is the collective resources possessed within and by the collective group and available to them.

Social capital can then be further divided into three different types of connections between individuals. Groups can have bonding social capital, bridging social capital, or linking social capital (17,20,21). Bonding social capital denotes social connections in social networks with strong ties such as relationships with family members, church groups, country clubs and fraternal organizations, and strengthens the ties within a particular group (17, 21). Bridging social capital unifies people with weak ties among heterogeneous groups and strengthens the ties across such groups (21). Finally, linking social capital relates to connections in the civic community to the political and financial environment (17,22). The key function of linking social capital is the capacity to leverage resources, ideas, and information from formal institutions beyond the community (22). Putnam focuses on bridging social capital. He argues the public gathering places allow for shared experiences among loosely tied individuals; providing opportunities for bridging social capital (17,21). From bonding, to bridging, to linking social capital the connections between individuals become less and less personal. Through bonding, bridging, and linking social capital people are more connected to each other, which potentially provides resources that are not otherwise available to an individual on their own.

Based on Coleman's definition that social capital is an attribute of the collective rather than the individual, this study aims to test the assumption that everyone in a geographic place shares the same collective benefits from social capital by examining social capital in Georgia counties. This will be done using a social capital index created based off of Putnam's definition of social capital. Both themes presented by Coleman and Putnam are critical in the further understanding of social capital.

How Social Capital is Measured?

The various definitions of social capital pose an epidemiologic challenge of definition and valid measurement, thus no standard way to measure social capital exists. Without a clear understanding of the definition of social capital, it is difficult to determine if measures are valid. The ideal measure would encapsulate aspects of bonding, bridging, and linking social capital. However, it is often difficult to include all aspects in one instrument. Studies that examine social capital typically measure it through a compilation of survey questions, or from a more formalized index (23). Researchers have used both national survey questions and original survey questions to measure the social capital of an area. Questions regarding one's trust in their community, social support, and civic participation are used to get a notion of collectively available resources and measure social capital (4,24). The individual responses are aggregated together to form a collective response by averaging the survey responses for the particular geographic area. Questions addressing social/emotional support in the Behavioral Risk Factor Surveillance System (BRFSS) has been used to measure social capital in this way (23,25). The percentage of adults with high social/emotional support was used as a measure of social capital in a study examining US state and county level social capital in relation to obesity and physical inactivity (25). Here the BRFSS measure of social/emotional support is used as a proxy for measuring the collective social capital, which individuals can draw on in times of need. Aside from national data, researchers have created their own surveys to measure social capital. A study of rural African

Americans in central Virginia measured social capital as frequency of church attendance, community organization membership, employment outside of the home, marital status, and telephone service at home (26). This survey focused on measuring bridging social capital by gathering information regarding public gathering places and other services. A different study evaluating social capital and black all-cause mortality in Philadelphia used respondent's assessment of livability of their community, the likelihood of neighbors helping one another, the sense of belonging, and the trustworthiness of their neighbors to measure social capital (24). These studies illustrate the vast difference in questions that can be used to measure social capital, making it very difficult to evaluate the validity of these measures.

Another method for measursing social capital is by using a calculated index. The previous measures were created from the aggregation of individuals' responses, where as indexes are created from a number of administrative or previously aggregated variables. In the United States there have been a number of indexes created to measure social capital at both the state and county level. The most commonly used state social capital index was created by Putnam and is based on a series of social surveys and administrative data during 1974-1994 (21,23). Kim later updated Putnam's social capital measure to the 1990's using updated data sources, and through factor analysis assigned ten of the indicators to two scales (25,23). Ruspsingha created a different social capital index using fifteen different variables which measure aspects of social engagement, public gathering places, and service environment across all US counties (27). Through the various components of the index, Ruspsingha is able to measure bridging and linking social capital. Unlike the original surveys, many of the indices used to measure social capital have been validated. A study examining the face validity, content validity, convergent validity, nomological validity of state and county social capital indexes found the Ruspingha to be a valid method to measure county level social capital compared with the BRFSS measure and the Petris index (23). The study also compared the performance of the social capital measures in predicting the following health outcomes: premature death, poor physical health days, poor mental health days, and self-rated health. The Ruspingha index was found to be more inclusive then the Petris index and covers the structural domain of social capital more completely by including a more diverse array of organizations. The Ruspingha index showed expected association with the Gini coefficient and violent crime rates, and was associated with premature death, poor physical health dates, poor mental health days, and self-rated health (23). The Ruspingha index has proven to be a very useful, valid tool for research related to the social capital process at the US county level (23). Table 1 displays the variables that comprise the Ruspingha index. This study will utilize Ruspingha's social capital index to measure social capital in Georgia counties.

Social Capital and Health

The concept of social capital influencing health has been around since the existence of the term social capital (16). A study conducted in Swedish men who were born in 1914 found that good social support and strong social networks was associated with decreased all-cause mortality (16,28). In the last 20 years, many social capital studies have been related to health outcomes (16,17). The more social capital an area has the better their health outcomes are (17,18,29). For example, people living in areas with low social capital are more likely to score poorly on self-rated health measures, even controlling for individual risk factors (16,19). Another study found positive health and developmental outcomes for high-risk, pre-school children are associated with high levels of social capital (16,30). Aside from social capital being associated with general health status, social capital has also been found to be associated with specific health outcomes. Having high social capital provides a protective effect on obesity and leisure-time physical inactivity (25). Additionally, people living in communities with higher levels of social capital are more likely to be non-smokers (4). High social capital has consistently been associated with positive impact on health outcomes.

There are a number of mechanisms that have been postulated for the association between social capital and health. Collective social capital is thought to benefit the health of individuals and to be a means for achieving collective ends that are independent of a group's material wealth. Social capital is also hypothesized to lead to improving individual access to resources through social networks (24,29,31). When social capital is greater, individuals' social networks may provide greater access to resources such as transportation, physician referrals, hospitals, recreational activates and other healthcare services which can ultimately lead to better health outcomes. Social capital has been proposed to contribute to better health by the promotion of health behaviors through social norms (24,29,31). Social capital may influence health behaviors by establishing social norms supporting those healthy behaviors (31). Social capital is also hypothesized to affect psychosocial processes, which increase positive feelings of subjective well-being, self-esteem, hopefulness and control over one's health (24,29). Aside from benefiting the health of an individual, it is hypothesized that social capital can benefit the collective group by fostering egalitarian democratic political participation thus leading to the development of policies that protect all citizens, resulting in better health outcomes (29,31). Through all of the provided mechanisms, higher social capital is hypothesized to benefit health.

Access to health care is a mechanism which affects both health benefits associated with social capital and disparities found within STI rates. High social capital promotes access to local health services and amenities through social networks (3,24). Therefore, areas with high social capital may be more likely to have better access to healthcare and disease prevention knowledge and practices. Similarly, areas with higher access to health care are less likely to be areas with age, gender, and racial disparities in STI rates (1,6, 9,10).

Social Capital and Sexually Transmitted Infections

Although there have been many studies examining the association between social capital and health generally, there has been very little research evaluating the association between social capital and infectious disease, and an even smaller subset of those studies focus on relationship between social capital and sexually transmitted infections (STIs). A few studies have examined STI and social capital indirectly, and to date, there has been one study to directly measure social capital and STIs (31). A study evaluating the broken window theory of social disorganization and the risk of gonorrhea indirectly examined the relationship between social capital and a STI. The study analyzed the relationship between a measure of community disorder and gonorrhea rates in New Orleans neighborhoods (32). Although social disorder is not equivalent to social captial, the concepts are similar in that they both depend on community involvment. The study created a broken window index to measure social disorder in the community. The index included percentage of homes with major structual damage, minor structual damage, or cosmetic damage; the percentage of streets with trash, abandoned cars or graffiti; and the number of physical problems and building code violations in public high schools (31,32). The study found that gonorrhea rates were significantly higher in neighborhoods with both high broken window indexes and high poverty indexes.

The one study which has evaluated social captial and STIs directly used Putnam's state social capital index to measure correlations between social captial and gonorrhoea, syphilis, chlamydia and AIDS rates (31). The study concluded social capital was correlated with all four health outcomes. States that had higher social captial index scores had lower rates of STIs (31,32).

Both of the studies presented found that higher social capital is associated with lower STI rates. In both studies, social capital is measured for specific geographic locations and investigators made the implicit assumption that the association between social capita and STIs are homogenous across strata of age, gender, and race within those geographic locations. However, this assumption may be incorrect. The rate of STIs is not equal among all ages, races, and genders, especially for chlamydia (1). This study will examine chlamydia rates and social capital in Georgia in order to test for heterogeneity of association by race, gender, and age.

This thesis aims to further examine the relationship between social capital and chlamydia rates. The burden of chlamydia infections is an ongoing problem concerning public health with large geographic, racial, age, and economic disparities. Social capital has been found to be correlated with several health outcomes. However, only a small subset of social capital studies involves infectious diseases such as sexually transmitted infections. There is a need to better understand the assumption that everyone in a geographic place benefits from social capital equally. There has been very limited research conducted to determine if all racial and gender sub-groups residing in a common area share equally in a type of social capital measured at a geographic level. The purpose of this study is to use county level chlamydia rate data from the Georgia Department of Public Health as accessed through their online system OASIS, and Rupasingha's county level social capital index to estimate the association between social capital and chlamydia rates among sub-groups defined by race and gender in Georgia.

Methods

Data

The data for this analysis comes from several sources. The Georgia Department of Public Health's Online Analytical Statistical Information System (OASIS) provided chlamydia cases and rates from the 159 Georgia counties from 2005-2009. Georgia OASIS provides morbidity, mortality, maternal and child health, and infant mortality state and county level data (33). The chlamydia data used in this study is cross-stratified by age (15-17, 18-19, 20-24, 25-29, 30+) , race (black, white), and sex. County level social capital data is from the Penn State University's Northwest Regional Center for Rural Development, created by Rupasingha. Rupasingha created a county level social capital index for the United States using data from 1990, 1997, and 2005(34). This study utilizes the 2005 social capital data for Georgia counties. Area-based covariates including poverty, urbanization, and percent black data came from the 2005-2009 American

Community Survey (ACS) 5-Year Estimates. ACS is a series of monthly samples, conducted by the U.S. Census Bureau, to produce annually updated data for the same small areas (35). The study was exempt from IRB review because no human subjects were directly involved.

Inclusion/Exclusion Criteria

The analysis is centered around chlamydia case rates for demographic sub-groups with all Georgia counties. All chlamydia cases that were reported by the Georgia Department of Public Health that could be linked to a specific county of residence, age group, race, and gender were included in analysis. Chlamydia cases that were not linked to a specific Georgia county were not included in analysis.

Definition of Exposure

To assess social capital in Georgia counties, the Rupasingha social capital index was used. The index was originally created using principal component analysis, where the first component explained about 46% of the variation in the data and was considered the social capital index. The index is comprised of the following four variables: total count of organizations per 10,000 people, number of not-for-profit organization per 10,000 people, census mail response rate for 2005, and vote cast for president in 2004 divided by the total population of age 18 and over in 1990. The total organizations per 10,000 people variable consists of the sum of the count of bowling centers, civic and social associations, physical fitness facilities, public golf courses, religious organizations, sports clubs, managers and promoters, membership sports and recreation clubs, political organization, professional organizations, business associations, labor organizations, and membership organizations not elsewhere classified in each county. For analysis the social capital index was standardized and categorized into quintiles (very low, low, medium, high, very high).

Definition of Outcome

Chlamydia rates in each county represent incident cases and allow for a person to be counted more than once if they have multiple infections in a single year. County level chlamydia case counts and persons at risk were captured separately for each race, age, and sex group (n=20 unique strata) in each of n=159 counties pooled for the years 2005-2008. From these data stratum-specific rates were calculated. The county level chlamydia rates from 2005 to 2008 were aggregated together to create a total rate. To protect the confidentiality of Georgia residences, the Georgia Department of Public Health does not calculate the chlamydia rate for counties that have fewer than four cases. For these instances the rate was calculated using the county population from the 2010 Census as the denominator.

Additional Covariates

Study analyses also controls for some established covariates that could be associated with social capital, and influence chlamydia rates. These include individual demographic factors such as age (15-17, 18-19, 20-24, 25-29, 30+), sex (male, female), and race (black, white), as well as county-level confounders such poverty rate, urban/rural and percent black. For this analysis poverty rate is defined as the percent of people living in the particular county who have been below the poverty line in the last twelve months. Percent urban is defined as the portion of a particular county population who live in an area with 50,000 people or more. Additionally, percent black is defined as the portion of a particular county population who are black.

Analysis

A descriptive analysis of the data was performed to evaluate the balance of covariates across strata of the social capital index and variation in the chlamydia rates across the covariates. This was done by reporting the mean values for quintiles of social capital at each level of age, sex, race, percent black, urbanization, and poverty. Additionally, the average number of chlamydia cases was calculated for each level of age, sex, and gender.

Next, multi-level Poisson regression models using generalized estimating equation (GEE) were constructed, where the chlamydia case count was the dependent variable, and the log of the population was an offset. The models were constructed using categorical covariates: age (15-17, 18-19, 20-24, 25-29, 30+); sex (male, female); and race (black, white), continuous covariates: poverty (percent of people who have been below the poverty line in the last twelve months); urban (portion of a particular county population who live in an area with 50,000 people or more); black (the portion of a particular county population who are black), as well three-way interactions between social capital, race, and sex including all subordinate two-way interactions. Backward elimination was used with interaction terms removed successively with the aims of retaining terms reaching significance levels of $p < 0.05$. Confounders were then assessed in the models by identifying whether the association between social capital and chlamydia varies by more than 10% in models without versus with a given covariate, and then subsequently using the most precise subset among eligible subsets of covariates. All analyses were completed with SAS 9.3 Software for Windows, licensed to Emory University School of Public Health (36).

Results

Descriptive Analysis

Overall, there were 158,863 reported cases of chlamydia in Georgia from 2005 to 2008, and the overall chlamydia rate was 430.1 cases per 100,000 people. This rate exceeded the 2009 national average of 409.2 cases per 100,000 people (37). Table 2 displays chlamydia rates per 100,000 people by age, sex, and race in Georgia. The chlamydia rates were the highest in 18-19 year olds, females and blacks.

The distribution of sample by the exposure (social capital index) and covariates is shown in Table 3. All age and sex groups appear to be similarly distributed among the various levels of social capital. Counties with very low social capital had the smallest portion of people for all age groups and conversely counties with high social capital had the largest proportion of people. The distribution of blacks and whites in the various levels of social capital appears to be relatively evenly distributed. About 50% of whites live in the two highest social capital levels and about 65% of blacks live in the two highest social capital levels. The percent of people living in poverty, percent of black people, and percent of people living in urban areas seems to be evenly distributed among all levels of social capital.

Table 4 displays the distribution of chlamydia rates per 100,000 people across the five levels of social capital by race. For blacks, the highest rate of chlamydia was in counties with very high social capital (897.8 per 100,000 people) and the lowest rate of chlamydia was in counties with low social capital (568.2 per 100,000 people). For

Whites, the highest rate of chlamydia was in counties with very low social capital (94.9 per 100,000 people) and the lowest rate of chlamydia was in counties with very high social capital (55.6 per 100,0000).

Regression Analysis

Three Poisson GEE regression models were fit: the crude model (model 1), multivariable model (model 2), and the interaction model (model 3). Table 5 displays the three models as well as the estimates for each covariate in the models. The prevalence ratios for chlamydia were calculated among the different county levels of social capital, using very high social capital as the reference group.

The crude model indicates a trend that counties with lower social capital have lower prevalence of chlamydia than counties with high social capital. However this association was not found to be significant at any level of social capital. Table 6 shows that counties with the lowest social capital have a lower prevalence of chlamydia compared to counties with the highest level of social capital (prevalence ratio [PR], 0.78; 95% confidence interval [95% CI], 0.57-1.06).

In the multivariable model (model 3), the 3-way interaction between sex, race, and social capital remained in the model as well as the related interaction terms to make the model hierarchically well formatted. The variable urban (portion of a particular county population who live in an area with 50,000 people or more) was dropped from the model following assessment for confounding. The variables left in the model after assessment for interaction and confounding are shown in Table 5.

Similar to the crude model, counties with lower social capital had a lower prevalence of chlamydia compared to counties with very high social capital. Unlike the crude model this relationship was found significant using very high social capital as the reference (Table 6). Using very high social capital as a reference, counties with very low social capital have a lower prevalence of chlamydia compared to counties with very high social capital (PR, 0.7; 95% CI, 0.609, 0.8047).

Model 3 took into account the 3-way interaction between race, sex, and social capital. Including the interaction terms in analysis provided drastically different results. For blacks, the higher the county level of social capital the higher the prevalence of chlamydia was. This relationship was found to be true for both black men and black women. However, it can be seen in Figure 1 that the effect is stronger in black men. Among black men, the prevalence of chlamydia in counties with very low social capital was half as high compared to the prevalence of chlamydia in areas with very high social capital (PR, 0.47; 95% CI, (0.31, 0.71). This suggests that living in areas with high social capital is harmful for blacks in terms of chlamydia prevalence. For whites the complete opposite was found because the higher county level social capital resulted in a lower prevalence of chlamydia. This trend was also found to be true for both white men and white women. However, the effect is more evident in white women (Figure 1). Among white women the prevalence of chlamydia in counties with very low social capital is 1.3 times higher than the prevalence of chlamydia in counties with very high social capital. These finding suggest that for whites, living in areas of high social capital is protective for chlamydia incidence. Figure 1 provides a visual representation of the effect of social capital by sex, and race. Table 7 displays the prevalence ratios of chlamydia by sex and race, comparing areas of very low social capital to areas of very high social capital.

Discussion

The results suggest there is heterogeneity in the association between county social capital and chlamydia rates in Georgia. Our data showed completely opposite associations between social capital and chlamydia for blacks and whites. For whites, the more social capital the lower the rates of disease and for blacks the more social capital the higher the rates of disease. The magnitude of these trends differed by gender. These findings are unique because prior research has shown that living in an area of high social capital is associated with better health outcomes (17,18,29). However, the results of this study show areas of high social capital are associated with better health outcomes solely for whites. Previous research has assumed that collective social capital measured in a geographic place was equally accessible to all groups residing in that place. This study found this assumption does not appear to be true. Previous studies that have made this assumption have found that areas with higher social capital have lowers STIs than areas with low social capital (31,32). Our results suggest that in Georgia counties, this relationship is only true for whites and that blacks are not benefiting from social capital the same way as whites, in relation to chlamydia. From these results, chlamydia control efforts should be focused in areas with high social capital for blacks and areas with low social capital for whites.

We can postulate several possible reasons why our results show there is racial and gender heterogeneity in the association between county level social capital and chlamydia rates in Georgia. One explanation could be there was not a failing of social capital for blacks, but a failing of our measure for blacks. We treated all social structure within a place as collectively accessible or beneficial. The social capital index used focused on measuring bridging social capital proxied by counting public gathering places in each county. It could be that this measure accurately measured social capital for whites but not for blacks. Our social capital index did not consider that bridging social capital could be differently distributed in the context of social segregation of public places. For example, one of the public gathering places counted was the number of golf courses in a county. If there are not any golf courses in predominately black areas but there are golf courses in predominately white areas, then counting the number of golf courses does not provides an insight regarding bridging social capital for blacks. Also, the historical racial segregation of sports such as golf could result in golf courses being limited to blacks, thus counting the number of golf courses lacks insight of bridging social capital for blacks. Additionally, this social capital index does not take into account that utilization of social structures could vary by race. Future studies that measure social capital should consider having a different measurement tool for blacks and whites in order to ensure that social capital is accurately measured for all.

Another possible reason for why our results show opposite trends for blacks and whites in the association between chlamydia and social capital is there is structural discrimination taking place. It could be that the public gathering places are allowing for connections to build among whites in ways that are disenfranchising to blacks. If blacks are not actively creating loose ties with people at these public gathering places then they are not reaping the benefits from these connections. Segregation has been thought of as a mechanism for creating disparities in STI rates (6,8,15). Segregation in a geographic area could result in area-based social capital not being equally available to all residents of a county, which can result in different races having different availability to social capital in the same county.

A third possible reason for why our results show opposite trends for blacks and whites in the association between chlamydia and social capital is that our social capital index is displaying the effect of racial differences in sexual networks. Blacks have been found to have higher rates of concurrency than whites (38,39, 40). Concurrency can increase rates of STI transmission (38). If counties with high social capital provide more opportunities for concurrency for blacks this could explain why blacks have higher rates of chlamydia in counties with high social capital compared to counties with low social capital.

Finally, the results found in this study could be a unique phenomenon occurring solely in the Southern United States. Future research should be conducted to determine if the pattern of opposite trends for blacks and whites in the association between chlamydia and social capital hold true in other parts of the country.

Study Strengths and Limitations

The main strength of this study is the large study size. Pooling together four year of chlamydia case data provided a large study size, which confers study power. One limitation of this study is validity of the Georgia STI surveillance system. Chlamydia is a mandatory reportable disease, but often not all cases are reported. It is likely that our analysis did not truly include all chlamydia cases in Georgia from 2005-2008. Also, due to the cross-sectional design of this study we are unable to establish causation.

Conclusion

Chlamydia is the most commonly reported notifiable disease in the United States with race and gender disparities. Social capital is a concept with growing interest in the public health field, underlining the need for a better understanding of how social capital impacts to infectious diseases such as chlamydia. This study found that the assumption that every person in particular geographic place benefits from social capital equally may not be accurate. The association between social capital and rates of chlamydia was found to be opposite for blacks and whites. For whites, areas with more social capital had lower the rates of disease, yet for blacks areas with more social capital yielded higher the rates of disease. It is essential to determine why these trends exist in order to work toward decreasing the burden of chlamydia.

Future Directions

This study demonstrates the importance of understanding the dynamics of the relationship between social capital and sexually transmitted diseases. A race-specific validation of current social capital measures to ascertain whether a measurement issue as a problem. Additionally, tools should be developed to accurately measure social capital among people of different races and genders. Additionally, further research should be conducted to determine if similar results are found in different geographic locations and using different STI outcomes. This information will aid public health officials in developing more targeted STI control measures.

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Tables

Table 1. Variables In Rupasingha Social Capital Index	
Variable Name	**Variable Description**
Organizations	
bowl05	Bowling centers
civic05	Civic and social associations
fitns05	Physical Fitness Facilities
golf05	Public Gold Courses
relig05	Religious Organizations
sport05	Sports Clubs, Managers and Promoters
memspt05	Membership Sport and Recreation Clubs
pol05	Political Organizations
prof05	Professional Organizations
bus05	Business Associations
labor05	Labor Organizations
memnec05	Membership organization not elsewhere classified
Rspn05	Census Mail Response Rates 2005
Pvote05	Vote cast for president in 2004/ total population age 18 and over in 2000
Nccs90	Number of not-for-profit organizations
a Data from County Business Patterns 2005 **b Data from 2000 Census** **c Data from National Center of Charitable Statistics**	

Table 2. Chlamydia[a] Rates per 100,000 Person-Years by Age, Sex, and Race in Georgia, 2005-2008.

	Rate		
Age			
15-17	900.9		
18-19	1582.8		
20-24	1185.9		
25-29	499.0		
30+	41.2		
Sex			
Male	172.0		
Female	399.2		
Race			
White	71.2		
Black	771.9		

[a] Chlamydia cases reported to Georgia Department of Public Health online System OASIS

Table 3. Distribution of Covariates Among Five Levels of Social Capital[a] in Georgia Counties

	Social Capital Index				
	Very low	**Low**	**Medium**	**High**	**Very High**
Individual Variables					
Age					
15-17	10.45	21.24	16.61	29.25	22.45
18-19	11.93	18.39	15.39	30.64	23.65
20-24	11.71	18.23	15.19	32.02	22.86
25-29	10.18	19.74	14.39	31.49	24.21
30+	9.45	20.65	15.84	30.15	23.91
Sex					
Male	10.1	20.65	15.8	30.11	23.34
Female	9.65	19.98	15.57	30.67	24.14
Race					
White	9.4	23.71	17.64	27.83	21.41
Black	10.89	12.78	11.35	36.06	28.91
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
County Variables (N=159)					
Poverty	19.89 (5.56)	19.03 (5.63)	18.93 (6.86)	19.56 (7.07)	18.38 (6.66)
Black	26.36 (18.25)	22.93 (14.85)	30.28 (18.46)	29.63 (13.63)	30.45 (20.80)
Urban	32.67 (25.64)	39.24 (25.79)	44.10 (28.37)	45.79 (31.08)	35.89 (33.0)

[a] County Level Social Capital based on Rupasingha's index

Table 4. Distribution of Chlamydia[a] Rates In Georgia per 100,000 Person[b] Years, Across Five Levels of Social Capital[c] by Race.

	Very Low Social Capital			Low Social Capital			Medium Social Capital			High Social Capital			Very High Social Capital		
	Cases	Population	Rate	Cases	Population	Rate	Cases	Population	Rate	Cases	Population	Rate	Cases	Population	Rate
Black	6202	933304	664.52	6221	1094833	568.21	7776	972605	799.50	23694	3089459	766.93	22239	2476998	897.82
White	1685	1774858	94.94	3364	4478845	75.11	2391	3332427	71.75	3767	5256636	71.66	2249	4043765	55.62
Total	7887	2708162	291.23	9585	5573678	171.97	10167	4305032	236.17	27461	8346095	329.03	24488	6520763	375.54

a Chlamydia cases reported to Georgia Department of Public Health online System OASIS
b 5-year population from 2005-2008
c County Level Social Capital based on Rupasingha's index

Table 5. Multi-Level Poisson GEE Regression Models for the effect of County Social Capital[a] on Chlamydia[b] Rates in Georgia.

		Model 1			Model 2			Model 3		
Paramters		**β**	**SE**	**p-vlaue**	**β**	**SE**	**p-vlaue**	**β**	**SE**	**p-vlaue**

SCI 1		-0.25	0.16	0.11	-0.36	0.07	<.0001	-0.14	0.16	0.41
SCI 2		-0.78	0.18	<.0001	-0.25	0.09	0.01	0.11	0.14	0.43
SCI 3		-0.46	0.22	0.03	-0.14	0.08	0.07	0.17	0.15	0.26
SCI 4		-0.13	0.20	0.51	-0.12	0.08	0.12	0.01	0.14	0.94
Age 1					2.92	0.07	<.0001	2.92	0.07	<.0001
Age 2					3.46	0.07	<.0001	3.47	0.07	<.0001
Age 3					3.20	0.07	<.0001	3.19	0.07	<.0001
Age 4					2.36	0.10	<.0001	2.36	0.10	<.0001
Race					-2.08	0.08	<.0001	2.89	0.19	<.0001
Sex (male)					0.89	0.08	<.0001	1.26	0.08	<.0001
poverty					0.36	0.09	<.0001	0.36	0.08	<.0001
% Urban					-0.03	0.01	0.03	-0.03	0.01	0.02
Race*VeryLow SocialCapital								-0.62	0.26	0.02
Race*LowSocialCapital								-0.83	0.21	<.0001
Race*MediumSocial Capital								-0.62	0.22	0.00
Race*HighSocialCapital								-0.26	0.20	0.19
Race*Sex								-0.64	0.09	<.0001
Sex*VeryLowSocialCapital								0.44	0.10	<.0001
Sex*LowSoicalCapital								0.21	0.10	0.04
Sex*MediumSocialCapital								0.10	0.10	0.35
Sex*HighSocialCapital								0.11	0.12	0.35
Race*Sex*VeryLowSocialCapital								-0.01	0.27	0.96
Race*Sex*LowSocialCapital								0.26	0.11	0.02
Race*Sex*MediumSocialCapital								0.26	0.12	0.02
Race*Sex*HighSocialCapital								0.05	0.13	0.72

[a] County Level Social Capital based on Rupasingha's index

[b] Chlamydia cases reported to Georgia Department of Public Health online System OASIS

Table 6. Prevalence Ratios (PR) for Chlamydia[b] Rates in Georgia, by Social Capital[c].

	Model 1[d]		Model 2[e]	
	Prevalence Ratio	95% Confidence Interval	Prevalence Ratio	95% Confidence Interval
Social Capital Index				
Very Low	0.78	0.57 - 1.06	0.7	0.61 - 0.80
Low	0.46	0.32 - 0.65	0.78	0.65 - 0.93
Medium	0.63	0.41 - 0.96	0.87	0.75 - 1.01
High	0.88	0.59 - 1.30	0.89	0.77 - 1.03
Very High[a]	1	-	1	-

[a] Referent Group.

[b] Chlamydia cases reported to Georgia Department of Public Health online System OASIS

[c] County Level Social Capital based on Rupasingha's index

[d] Crude model

[e] Controlling for age, race, sex, poverty, and percent urban.

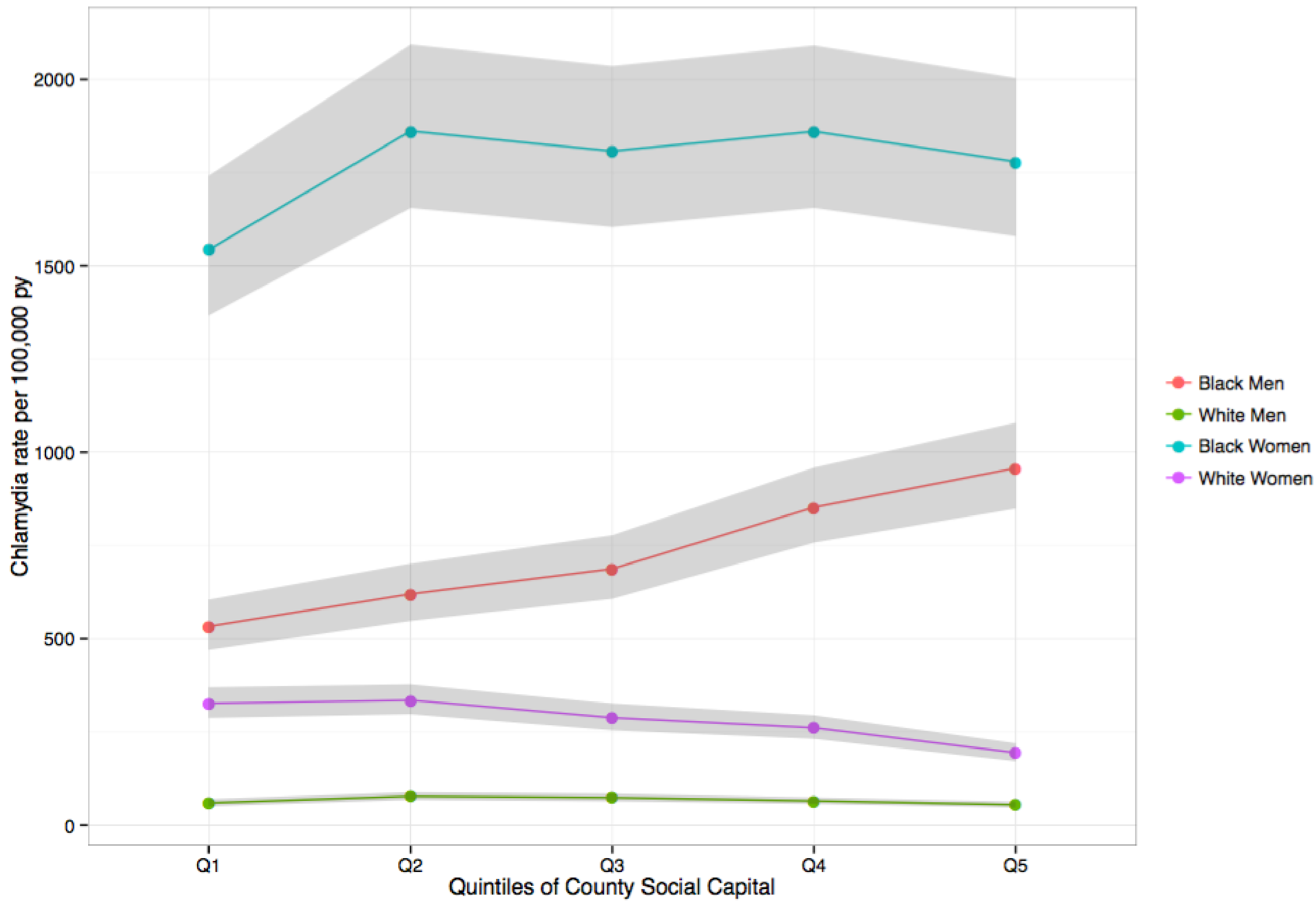
Table 7. Race and Sex Specific Prevalence Ratios (PR) for Chlamydia[a] Rates in Georgia, Comparing Very Low Social Capital[b] to Very High Social Capital[c].

	Model 3	

	Prevalence Ratio	95% Confidence Interval		
Social Capital Index				
Black Men	0.47	0.31- 0.71		
White Men	1.12	0.85- 1.48		
Black Women	0.38	0.63 - 0.47		
White Women	1.35	0.92- 1.97		

[a] Chlamydia cases reported to Georgia Department of Public Health online System OASIS
[b] County Level Social Capital based on Rupasingha's index
[c] Very high social capital is referent group, compared to very low social capital

Figure 1. Chlamydia Rates per 100,000 Person-Years in Georgia 2005-2008, Across Five Levels of Social Capital, by Sex, and Race Accounting for Three-Way Interaction Between Social Capital, Race and Sex.



2000
1500
1000
500
0
Chlamydia rate per 100,000 py
Q1
Q2
Q3
Q4
Q5
Quintiles of County Social Capital
Black Men
White Men
Black Women
White Women